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ADDITIONS

IN

AGRICULTURE.

ADDITIONS IN AGRICULTURE.

The Thanks of the Society were this Session voted to THOMAS SKIP DYOT BUCKNALL, Esq. M. P. for the following Communication relative to the causes of BLIGHT ON FRUIT-TREES, and to the methods of producing good and certain Crops of Fruit; being a supplementary paper to various letters on Orcharding and Blight, already inserted in several volumes of the Socciety's Transactions. Mr. Bucknall has given a fresh instance of his good intentions towards the Society, by the present of an engraved Plate annexed, describing three niduses of Insects; the mode he recommeds of planting dwarf and standard Fruit-trees; and a ground plan of Mr. Lake's Orchard, noted in page 96, which was laid out under Mr. Bucknall's direction.

Dear Sir,

I HAVE read over your observations on Blight with great pleasure; and I do not feel that I have any thing to add, except that much may be done by choosing fruits whose blossoms are patient of cold and wet, as well as of heat; and such, I know, may and will be obtained from seed. I have now among my new fruits some whose blossoms are so tender, that every one will fall with a degree of cold that will not be fatal to a single blossom of an adjoining tree. I do not attribute this solely to any defect in the blossom of the one, or to the perfection of the other, nor to want of health; but I have good reason to believe, that the same degree of cold which will suspend the progress of vegetation in one plant (and, of course, in every graft taken from it), and paralyse all its powers, will have no sensible action on another. Health, I admit,

mit, will do much, and youth (or young variety) will, I think, do more; for I see many of my new fruits, which bore heavily last year, prepare to blossom again with vigour this year: but much will still depend on the varieties being naturally patient of cold, &c. Last year I had frequent occasion to observe, during the autumn, that the same crop of fruit which totally suspends the growth of a grafted tree of a middle-aged variety, will scarcely affect that of one whose parent stock has but just obtained the bearing age.—When you reprint your Orchardist, I shall have great pleasure, if I can send you any thing worth adding to it. It is my intention to pay much regard to the progress and suspension of the sap in changeable weather next spring; and something may possibly occur that I may think worth sending you. I am about publishing a second edition of my Treatise, much enlarged; but I have not yet found industry sufficient to complete it.

Yours sincerely,

THOMAS ANDREW KNIGHT.

Elton,
June 3, 1800.

To T. S. D. BUCKNALL, Esq.

SIR,

UNDER the Classes 80 to 83, in the 17th volume of your Transactions, very handsome Premiums are offered for preventing Blight on Fruit-trees, or taking off their ill effects. Having long attended to the subject, and being anxious to gain further information, I dedicated my time, during the month of September, 1797, to a tour through the Cider-countries; also during the greater part of June and July, 1798, and August, September, and October, 1799; choosing to vary the months in each year, for more full information on the subject: and I beg this may be considered as a further attempt to ascertain the causes of Blight, and trace the most effectual means of preventing or taking off its ill effects, and in part disposing the trees to produce a small valuable crop of fruit nearly each year, instead of suffering what in the Cider-countries is called a *hitt*, which generally happens once, twice, or thrice in nine years. This hitt, or superabundance of fruit, is very destructive to the trees; for so great a crop weakens them very much, filling the stores with fruit and liquor to an extent far exceeding the stock of casks and cellar-room, so as to confound the grower, lessen the value of the property, and intoxicate the country.

This evil is noticed by Billingsly in his report for the county of Somerset, wherein he says, many sensible men are of opinion, that Cidering to any great extent wastes the land, and is detrimental to the country. I, who choose to take the other side, aver that a fifth part of the land now appropiated to orcharding, were it judiciously managed, would produce to the country more value in money than all the present plantations, and make that business a real source of riches to the nation. Should a few ingenious men, in good situations, turn their thoughts to Cider-making, choose those new varieties which are known to possess superior qualities, and make Cider an article of trade to the West Indies, the Orchards would have a very different appearance from the present. It would be very easy to give a stronger body to the Cider, so as to bear exportation, merely by a process on the juice of the apple.

The Orchardist had sufficient rules for general practice as to the management of Fruit-trees, at the close of the Paper in the 14th volume, had not Blight, and the natural effects of the different varieties of the Cider-fruits been started, which led me to think it necessary to improve the work, by adding a Paper, in the 17th volume of the Transactions; and I now beg your indulgence for the following remarks

On Blight.

This being intimately connected with my favoutite object, the improvement of Fruit-trees, I shall submit to your observations a further collection of facts, which I think will tend considerably to lessen, if not in part eradicate, this growing evil.

Blight originates from many causes; several of which I have pointed out before, each requiring a different description and mode of treatment, according as it arises from the air, soil, water, heat, extraneous vegetation, accidents, or insects. I shall therefore treat of Blight under these different heads.

A free circulation of air is essentially important to secure the health of the tree; indeed there can be no good vegetation without it.

Absorption and emission of air are well known to take place throughout the vegetable system for its support; and where circulation is impeded by a multitude of branches, or by trees standing too close together, Blight is the inevitable consequence. This, therefore, may be prevented, by clearing away the clustering branches long before they may have so far encumbered the trees as to give them a disposition to blight, as I have remarked in the first paper on pruning:

"Consider whether a branch will be in the way three years hence; if it will, the sooner it is taken off the better."—Eleventh Volume, p. 18.

Mr. William Lake has observed to me that Fruit-trees should be left with one aspiring top, which tends, where pruning is neglected, to keep the branches more equally asunder. Remember, no leading branch is ever to be shortened, except to improve the figure of the tree; in which case it is to be cut close to the separation.

When the branches or trees are so close together as to prevent a free and active circulation of air and sun, the encumbered parts soon decline in growth, and the due flow of the sap is obstructed, the wood grows torpid, rots, dies, and falls off. When this happens, the grass beneath ceases to grow; a cold, damp, offensive smell arises; few blossoms are formed on those parts of the tree, and those never duly impregnated; consequently, the branches become unproductive, and are justly said to blight.

Now, to place this evil in its true light, I wish I might be allowed to use the word pulsation; for, in a healthy tree, when the sap flows, there is a regular irritation or motion, which impels it forward: the organization of this function, being very delicate, is easily destroyed; and there is no other way of removing the evil than by cutting off the torpid branches, and clearing away whatever may obstruct the sun and air; and, in general, if the habit of the tree be healthy, these parts will recover.—'Remove the cause, and the effect ceases.'—This I noted in the 14th volume of the Transactions, and in the Orchardist.

The soil is another most material object of attention in the management of Fruit-trees, on which I shall only observe, that if the soil is replete with mineral particles, they may occasion blight by obstructing those vessels in the roots which convey nourishment to the plant. In such soils you may frequently, on minute examination, observe a yellow or orange-coloured calx of iron separated from the earth, and precipitated on the roots, which prevents the absorption of proper food. Soils containing metals which dissolve in water, should be avoided;

but if a plantation has been actually made in such soils, the best method of preventing the Blight arising from this cause is to cut away the tap-roots which have struck into the under-soil, and encourage the increase of those which run horizontally. But the most important and beneficial precaution is to lay a good coat of manure upon the surface, as soon as the under-roots are taken off.

Water is most frequently the cause of Blight, particularly from land-springs, which should be carefully drained off, otherwise it were better never to plant at all. The best method is to let the drain run directly under the respective rows of trees; but be sure they be not small. The most completely planned orchard I ever saw has been totally ruined for want of this precaution, and a sufficient quantity of manure; and a tree, now one of the finest More-park apricots in this country, was planted seventeen years ago, by way of experiment, on the crown of a large stone-arched cellar. These facts are well worthy of attention. Whenever the land is kept cold from under water, Fruit-trees can make no progress, and generally canker; also, where water remains stagnant for any length of time about the roots of trees, the tender fibres are chilled, and thereby destroyed. I am here only speaking of noxious waters; for pure water judiciously, frequently, and sparingly applied, is one of the best agents for keeping Fruit-trees in permanent health: first take all the proper precautions, then water, and the tree will probably not blight. This must, of course, be understood of good situations.

Heat, much oftener than cold, proves destructive to vegetation, by causing blight. I speak of the quick transition from heat to cold, for that does the mischief. Thus, what is called honey-dew, originates from heat checked by succeeding cold, which occasions the sap and saccharine juices to coagulate on the surface of the leaves, and greatly injures the tree, by impeding its growth. But I have more fully considered the alternate succession from heat to cold in my last paper. See Vol. 17th.

Honey-dew is very detrimental to trees, by stopping the pores of the leaves. Old and decayed trees are much subject to this evil, from the sap running more to a saccharine juice.

Mr. Knight, and the Author of the Worcester Report, ascribe honey-dew to insects. Should it be insects, the fat of hogs, or rusty bacon, rubbed on the body of the tree, would disgust them, and prevent the mischief, and would also keep hares and rabbits from biting the bark.

Blight is also caused by extraneous vegetation, I mean moss or other vegetable productions, that are suffered to grow on the bark of fruit-trees: these prey upon the juices and nourishment of the plant; and, by preventing a proper circulation of the sap, produce blight. This evil, if taken in time, is so easily removed by the brush and soap-suds, that I shall not enter further on the subject here, than to remark, that washing makes the stem and branches most delicately smooth and soft, if the practice be taken up from the first plantation of the tree.

Accidents, carelessness, and the suffering vermin to continue eating and fretting the tender bark, are very great causes of blight, often debilitating a large branch in a short time, and bringing on sure destruction to the tree. This is most effectually prevented by cutting and cleaning out the wounds, and using the medication as directed in the 11th volume, where there is a note on vermin. To avoid any of the causes above enumerated, examine the trees often, and remove all the

Impediments to Health,

as soon as they are perceived. Do not regard the time of the year, but stop every evil in the bud; and be assured that the knife does not injure the tree even in summer, and when it is full of leaves, for the growth is then so free that the wound only heals the better. Summer, indeed, is the best time for scoring trees, when the bark is too close for the tree to grow.

I shall now notice the last, but, by no means, the least of the causes of blight, which I have mentioned before, in the 17th volume of your Transactions, p. 274; I mean INSECTS, which are certainly the grand cause. I have there given it as my opinion, "that insects do not come over in the winds from the Continent, but are bred at home, from the eggs deposited about the tree in summer and autumn."

I am well convinced, that a minute observer will find this to be the fact; and, in confirmation of my opinion, I beg leave to lay before you three niduses or repositories for the eggs of insects: one of which contains 578 cells, another

650, and a third 880; each nidus being formed upon, and adhering to a very small twig: the account of which is well authenticated, and leads to a consideration of the power of insects to do much mischief to infantine vegetation. I beg those Gentlemen who have patronized attempts to raise silk in this country, and have observed the production and nourishment of the Silk-worm, to consider the probable quantity of leaves and blossoms that are eaten by insects; reflect upon the quantity of vegetable matter required for the nourishment of 2108 insects, the number produced in these three niduses; and observe the small space they occupy, and how easily they escape notice. An engraving of two of these niduses, in their natural size, appears in *Plate VI. Fig.* 3.

For destroying insects, I cannot too strongly, or too often recommend the frequent and careful examination of Fruit-trees, and the gathering every nidus that may be found. The task is not so difficult to execute as it may at first appear, and should be undertaken early in the spring, before the buds expand; you may then destroy in a short time many receptacles of 500 to 700 insects, which cannot, at a more advanced age, be killed by fumigation, or collected by the hand, without infinite trouble. The niduses should be collected in a bag or box, and burnt; for if merely thrown upon the ground, the insects will still be produced.

The niduses are of various kinds; some adhere to the bark of trees, and contain an infinite number of small cells, in which the ova are deposited, as in the specimens I lay before you. Others are formed in small bags, or downy matter, of a substance resembling a spider's web; others in leaves, curled up with great care. It is in all these stages of their production that they should be discovered and destroyed; otherwise the same warm day that brings forward vegetation, hatches the insects, supplies them with food and shelter, and renders the evil difficult to be cured, though at a more early stage it might easily have been prevented.

As a proof that this operation is neither difficult nor tedious, it has actually been practised during three successive years, on four acres of a newly-planted Orchard, of which proof has been adduced before the Society. I would say to the public, ' Go thou and do likewise;' but the greater part of the trouble may be saved by proper cleaning in the preceding autumn.

Were it possible to contrive a regularly progressive flow of heat and cold, according to the will of the director, and regulated by the thermometer, Blight might actually be prevented. To prove this, I mentioned *the Hampton-Court Vine* in my paper inserted in the Transactions of the Society last year. This plant is kept perfectly healthy and productive, merely through being regularly washed, pruned, cleaned, and protected from the external elements.

Let thus the attentive Orchardist see, foresee, and remove every evil in his power, and nature will do the rest.

These various modes of preventing Blight, according to circumstances, are confirmed by my own observations, during more than ten years of assiduous care and attention, and have approximated as nearly to the object as the nature of the case admitted. It is my wish the Society should be in possession of a regular series of principles on this important subject.

It is not easy to imagine how much benefit would result from what I call plantations of slips, shaws, and shelter, to protect the blossoms in spring, and the fruit in autumn. See *Plate VI.* To explain this, let four acres and a half be marked out for an orchard; then plant a slip of land, one pole wide, with sweet chesnut Huntingdon willow, or any other free-growing wood, in six rows, extending along the three cold sides. If the ground be twenty-seven poles square, this slip would occupy half an acre, and if kept clean, the wood would more than pay its expence; whereas to build a wall to this extent, would require a thousand pounds, and not be so efficacious. In the Green Park, Westminster, is a plantation of horse-chesnuts, about eight years old, feathering down to the ground. Such trees would afford ample protection to a plantation so defended.

Let the shaws be properly raised, as before directed, to secure shelter and warmth to the plantation. Make the trees perfectly clean in autumn, and cover the ground, as far as the roots may be supposed to extend, with proper manure. Examine the buds as they swell; and, if strong easterly drying winds prevail in the spring of the year, then eject, with a garden machine, two or three pails of water every morning, over the whole tops of the trees.

It may be said, that it is impossible to do this on an extensive plantation; but let me advise the experiment to be made on a few trees, and you will find the time to be well employed; and if there is a great return from the produce, you will be encouraged to persevere. One great objection may be the want of manure, as that, you may suppose, cannot be spared from the farm-yard dung. I can however suggest a method whereby you may constantly procure, for four acres of land, as much manure as is necessary for a term of twenty-one years, without expending six-pence. This will be explained under an account of an Experimental Orchard, or Fruit-Garden.

I am not ashamed to own, that I feel a pride in being able, so far, to have accomplished the improvement of standard fruit-trees, to some satisfaction. The principles I have endeavoured to establish may be depended upon; but the practical part still remains very defective, and will depend on the energy and exertions of the country at large. I would particularly request gentlemen to consider the power of the new varieties. At a distance from towns, few persons are without one or more apple-trees; therefore let me beg that each may do something, for public happiness is but the result of that portion of general good, which arises from the exertions of individuals.

With the highest respect to the Society, for their regular attention to my observations, and attempts to perfect this valuable branch of Agriculture, which sheds upon mankind the blessings of Pomona,

I am, Sir,

Your most obedient servant,

T. S. D. Bucknall.

Hampton Court,
February 25, 1800.

Mr. Charles Taylor.

SIR,

THOUGH the time of the Sessions is over, permit me to add a few observations, and a further proof, that insects are deposited about Fruit-trees, and are a material cause of Blight.

A short time past, I requested Messrs. Kirks, Nurserymen, at Brompton, to look over their plantations, to procure me two or three niduses. I left a box, containing three, at the Society's Rooms, which was opened there by Mr. Thomas Taylor and myself, on the 14th of June last, upon which there issued from it swarms of animalcula, running out of the box, and over the desk and papers; many lay at the bottom of the box, and we supposed had died for want of food. When the active ones became sufficiently settled for us to form an opinion of their number, it was imagined they amounted to between 1500 and 2000. We had no glasses to examine them; but they appeared to the naked eye, both in size and colour, like so many small fleas.

I must remark, that Messrs. Kirks, at my desire, have undertaken to keep a register of such apples of the new varieties as may come to their knowledge, to show the trees and their fruit to their customers, and to point out where the original, primogenious, or parent stocks were raised; with other circumstances necessary to form an opinion of the value and uses of such new varieties. I particularly request that gentlemen who may be so fortunate as to raise any, would be so obliging as to send four grafts to Messrs. Kirks, to enable them to supply a part of their plantations, assigned to these experiments.

I have herewith sent to the Society, a Ground-Plan of Mr. Lake's Orchard, situated at Woodstreet-Farm, in the parish of Bapchild, in Kent, and described at page 96 of this volume as the Orchard, *No.* 1: the trees are now sheltered by the hops, which are to be removed before the Fruit premium is to take place.

When the new hedge to the northward is fully grown, as high and thick as nature will carry it, the Orchard A, *No.* 1. *Plate VI. Fig.* 1. consisting of four acres, one rood, seven poles, will be particularly well screened from the cold winds; and, in my opinion, the small opening to the Orchard B, *No.* 1. containing one acre, three roods, six poles, to the south, will admit a sufficient degree of warmth, and a free circulation of air. The method I recommend for planting standard and dwarf Fruit-trees, is shown in *Plate VI. Fig.* 2.

I have used my best endeavours, through the Transactions of the Society, for the space of the last eleven years, to elucidate the business of Orcharding;

and it is my wish to render it as perfect as possible.

I have the honour to be,

Sir,

Your most obedient servant,

T. S. D. Bucknall.

Hampton-Court,
September 17, 1800.

Mr. Charles Taylor.

[The *Plate VI.* to which the following DESCRIPTIONS apply, was presented to the Society by THOMAS SKIP DYOT BUCKNALL, Esq. M. P.]

DESCRIPTION *of Mr.* LAKE'S ORCHARDS, *noted as No.* 1, *situated at Bapchild, in Kent, for planting which he received a Premium of* THIRTY GUINEAS *from the Society; the particulars of which are mentioned at page* 96.

Plate VI. Fig. 1.—A, *No.* 1. is a ground plan of the Orchard, which contains the standard and dwarf apple-trees.

The standard-trees are planted 32½ feet asunder: two dwarf-trees are planted in rows between every standard; therefore forty-one standard trees and eighty-two dwarfs are planted upon each acre.

B, *No.* 1, is a ground plan of the Orchard, in which standard-trees only are planted, containing forty-one trees per acre; the intermediate spaces being filled with hops.

C, D, E, F. Shaws or shelter, planted with Spanish-chesnut, ash, &c.

G. A plantation of chesnut-trees.

H. A new hedge of quick to the north, to be trained as high and thick as nature can carry it.

DESCRIPTION *of the Method recommended by Mr.* BUCKNALL, *for planting Standard and Dwarf Fruit-trees.*

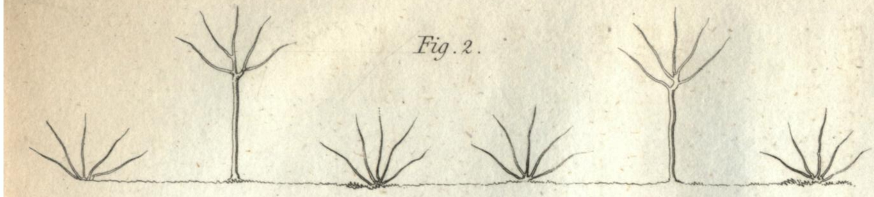
Plate VI. Fig. 2. explains the manner in which the two dwarf-trees should be planted between each standard: the standard-trees to be 33 feet apart: every tree to be pruned in such a manner as to make each row to become, thirteen years hence, an actual hedge of fruit; the intermediate spaces to be filled with hops, which are to be displaced as the trees advance in growth.

DESCRIPTION

PLATE VI.

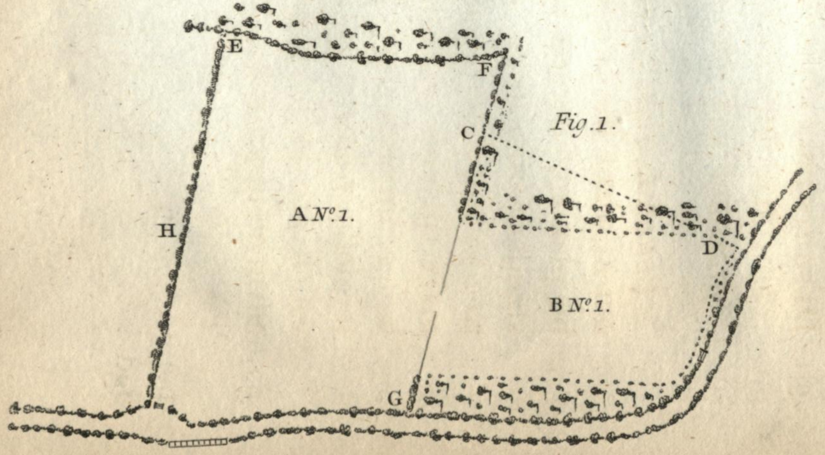
Mr. Bucknalls Method of planting Fruit Trees.

Fig. 2.



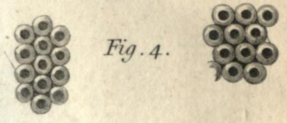
Mr. Lakes Orchard at Woodstreet.

Fig. 1.



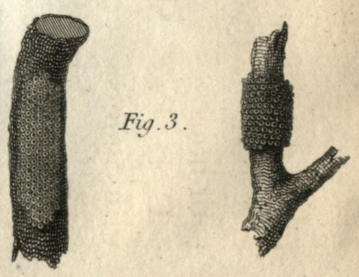
Niduses of Insects magnified.

Fig. 4.



Niduses of Insects of their natural Size.

Fig. 3.



This Plate was presented to the Society of Arts &c. by T. S. D. Bucknall Esqr.

Lowry sculp.

DESCRIPTION *of some of the Niduses collected by Mr.* BUCKNALL.

Plate VI. Fig. 3. *a*, *b*, represent two of the niduses of their natural size, adhering to the twigs of trees on which they were formed: each of these contained about 700 insects. On the twig *a*, the nidus encircles the twig like a gold thread lapped round it; but the nidus on the twig *b* is on one side of it only.

Fig. IV. shows the cells in which the insects were deposited, as they appeared when magnified by a microscope.

The following Accounts of the Culture of the BEET PLANT, the application of its Leaves as Food for Cattle, of its Root for making Sugar, of its Sirup as yielding Melasses and ardent Spirit, and of its Residuum for other useful purposes, have been lately sent from Germany, along with a Sample of the Sugar, by Mr. JOHN TAYLOR, of Leipsig, to the Secretary, and by him communicated to the Society.

DEAR SIR,

IN compliance with your desire, I have taken some pains to examine into the merits of the various processes for preparing Sugar from the Beet-root, and to gain information upon the culture of the plant. You well know that Director Achard, of Berlin, first introduced this subject into general notice, and recommended that the Sugar should be procured by boiling the Beet-roots, when taken out of the earth; that they be sliced when cold: that afterwards the saccharine juice be pressed out; that it be filtered, evaporated, and, after evaporation, the Sugar be procured by crystallization and pressure. That account having been printed in England, I shall not notice it further, but proceed to such other observations as have arisen from subsequent experiments.

The kinds of Beets which have been used for the preparation of Sugar from their roots, are varieties of that species called the Beta vulgaris, or Beta caule erecto of Linnæus, and of his Pentandria Dyginia class and order: they consist of the Beta rubra vulgaris, Beta rubra major, Beta rubra radici Rapæ, Beta lutea major, Beta pallide virens major, Beta alba vel pallescens quæ Cicla officinarum, and Beta communis viridis. Of these the principal are the Beta rubra vulgaris, runkel Rube of the Germans, or red Beet of the English, and the Beta Cicla, den weissen Mangold, of the Germans, or the white English Beet; and varieties of these whose roots have coloured rings.

Method of Culture of the BETA VULGARIS *of Linnæus;* RUNKEL RUBE, *of the Germans;* LA BETTE, *of the French; or* COMMON BEET, *of the English.*

THE soil should be a good black earth, not too moist; the land should be prepared as for cabbages, namely, dunged in autumn with short rotten dung, and ploughed; turned again in spring, and then ploughed a third time much deeper than before. The land on which (Kohl) white cabbage has been planted the preceding year, answers well for the culture of the Beet, such land having been generally kept clean from weeds, and well dunged. The seeds are usually placed from twelve to eighteen inches distant from each other, and one inch deep in the earth. The finger is used for the purpose, or an instrument resembling a bean-setter, with this difference, that the teeth are an inch long, and the above-mentioned distance from each other. In each hole one seed is laid, and immediately covered with earth. As the field where the Beet-root is sown is easily over-run with weeds, and the Beet-plants do not spring so soon as many of the weeds; therefore the ground must be weeded in four or five weeks time, and some weeks afterwards hoed: and since from one seed three or four plants frequently grow, or by negligence several seeds are sometimes thrown into one hole, therefore the extra plants must be drawn out to be placed where there are vacancies, and the weeds must be frequently destroyed. There is this advantage in sowing the seed in the method above mentioned, that the plants remain, and are not checked in their growth by change of situation. It is necessary, however, to pick out good and ripe seed, to prevent vacant places in the field.

Some prefer transplanting the roots to sowing the seed on the ground where the plants are intended to remain; and, in such case, make use of a stick to form the hole; the length of the stick determining the distance at which the plants should be placed from each other. After the plants have been some weeks in the ground, the earth should be loosened with a hoe, and the weeds destroyed.

The Red Beet is the kind which has been usually grown in the neighbourhood of Halberstadt; and the leaves of this, and the others, are eaten, when prepared, as spinach for the table; but are principally employed as herbage for cattle, who are fed therewith in the stalls.

The roots are pleasant food when boiled, sliced, and eaten cold, either alone or in sallads.

As the method which Professor Gottling has invented, to separate the sugar from Beet-roots, appears to me the most easy to be put in general practice, at little expence, and best calculated for Great Britain, I shall notice it more particularly.

He recommends the Beet-roots to be taken out of the ground about the middle of September, or from that time to the middle of October, in order to have good weather to dry them: they should be washed from their adhering earth, as speedily as possible, and their small fibres should at the same time be cut off; as likewise such part of the root as in growing had risen above the surface of the earth.

The roots are to be afterwards wiped with a cloth, and laid upon a dry floor; their heads are to be cut off and given to the cattle: the roots should be then sliced lengthways down the middle, each half again cut into thin slices, and loosely hung on strong thread upon nails, in an airy chamber or place secure from the rain. The slices should not be placed too near together, lest they spoil, nor too many be put upon one string, lest it should break; it is adviseable to turn the strings upside down, once or twice, to effectuate a speedy drying. In the course of ten or twelve days they become so dry that the strings may be removed nearer together, in order to allow fresh Beet-roots to be hung up, if there should be scarcity of room.

In the course of fourteen days, or three weeks, they will be sufficiently dry for their sugar to be extracted. In case there may not be sufficient room to dry them in the house, they may be dried in a barn, or any place secure from the rain. Instead of placing the sliced roots upon strings, stages may be made in outbuildings, or any place secure from the rain. The sliced Beet-roots may be laid on netted frames within them, as in glue manufactories; but as children may be employed to string them, you may dry on strings a greater quantity of Beet-roots in a small compass.

If the drying season is far advanced, or a frost expected, the Beet-roots should not then be exposed to the outward air, but dried in the kitchen or warm rooms on strings, or netted frames, resembling the flakes used in Yorkshire for drying oat-cakes; as the roots become dry, they may be placed closer together. The slicing of the Beet-roots, properly forms the evening's occupation: no more should be sliced at once than can be strung or placed on frames to dry, as it is not adviseable to let the roots remain in slices long in a heap. The roots may be dried in stove-rooms by artificial heat; but great care is then required to keep them free from smoak, or being burnt, otherwise the sugar will be dark-coloured, and of an unpleasant taste. It is better, therefore, not to dry the roots in stoves, unless in cases of necessity, such as where the frosts may prevent the roots from being dried in the open air.

The roots should be dried throughout, and not partially. If they appear grey on the outside, they should yet be inwardly white or red; and if chewed between the teeth, have an extremely sweet taste, free from must or acidity.

In large concerns, it would be best to slice the roots with machines contrived for the purpose: such as are used in England for slicing turnips, would do the business.

Where opportunity will not permit the Beet-roots to be sliced soon after being taken out of the earth, they should be placed in cellars, and covered with straw, or put into holes in dry sandy earth, and preserved till wanted, as potatoes are done in England.

In what degree the freezing, or longer preservation of the Beet-roots may affect their saccharine qualities, is not yet sufficiently ascertained. Some trials made at Waltersdorf did not seem to occasion any material alteration.

When the Beet-roots are dry, they are ready for their sugar to be extracted: you must then provide three wood-tubs, wide, but not deep: oak, ash, or willow will answer; but fir, or resinous wood is not proper for the purpose: earthen mugs may serve for family use. If you employ wood vessels, there should be cocks or spiggots near the bottom of the tubs, and the tubs placed in a cool situation between eight and ten degrees of Reaumur's thermometer, or fifty-two degrees of Fahrenheit's, upon a stillage, near to each other; and so high from the ground, that smaller vessels may stand below them, to receive the liquor when drawn off.

There should be good clear water near at hand, so as to be pumped into the higher vessels.

The Beet-roots having been dried, as above directed, must be sifted, to free them from the dust and loose fibres; then having half filled one of the higher tubs with clean roots, pour clear cold water thereon, to about one third in height above the roots: let them thus remain for three hours, stirring them at different times with a wooden paddle.

After the expiration of three hours, put into the second tub as many clean dried roots as had been placed in the first; draw the sweet liquor from the first tub into the vessel underneath, and pour it upon the roots in the second: then put into the first tub more fresh water, sufficient barely to cover the roots, and suffer the tubs to remain three hours more, stirring the roots repeatedly, as before.

The liquor which had been poured from the first to the second tub, will be now much absorbed by the roots in the second tub. After standing again for three hours, the sweet liquor from the second tub must be drawn off, which, if the roots were of the red and white ringly sort, will be of an agreeable red colour: it must now be run through a sieve, or filtered through a flannel, and should be fit for boiling down for sugar.

After this, draw the liquor from the first tub, pour it on the second, and pour on the first tub more fresh water, and let it stand three hours longer.

Then put into the third tub the usual quantity of dry roots, and pour thereon the liquor from the second tub: remove the liquor from the first tub to the second; and the roots in the first tub being now deprived of their saccharine matter, may be used for feeding hogs or cattle.

After three hours more, the liquor should be drawn from the third tub, by filtering, as before, and may then be boiled down for sugar.

Then draw off the second vessel, and pour the liquor into the third; add fresh water to the second vessel, and let it remain three hours more, stirring the roots from time to time.

During this time, cleanse out the first tub, and add fresh roots, as before. In three hours time, draw the liquor from the third tub, and pour it upon the fresh roots in the first; then draw the liquor from the second tub, and pour it on the third: the roots of the second tub will be now exhausted and may be given to the cattle.

After three hours, draw off the liquor from the first tub, filter it, and it will be ready to boil down. On the contents of the first, pour the liquor of the third, and put fresh water in the third tub; let it remain therein three hours, stirring it as usual: during which time clean out the second tub, and give the roots to the cattle..

In the second tub fresh roots are again to be placed: proceed by extracting the saccharine matter, as before, and continue the operation, till all the ready dried roots have been thus freed from their sugar.

By this management the liquor becomes more charged with saccharine matter than you find the juice is when pressed out of the roots, and a considerable quantity of fuel is spared. The roots from which the liquor has been extracted will have swelled much in the operation, and have lost their sweetness: their farinaceous residuum will, however, afford good food for cattle.

It is not adviseable to have the vessels made too large for extracting the sugar, lest there should be too much liquor to boil down at the last. For the same reason, I think it better not to pour water the third time upon the last parcel of dried roots, but rather use them immediately for food for cattle, as they will not pay well for boiling down.

Whenever there is a sufficient quantity of dried roots ready, the process of extracting the saccharine liquor should be continued day and night, as it is not proper to let the liquor remain longer than three, or at most four hours, before you boil it, lest a dissolution of the mucilaginous particles of the roots should take place.

If it is not convenient to boil down all the saccharine liquor at once to a state of crystallization, yet it should be daily boiled down to the consistence of a sirup, to prevent its fermentation.

In boiling the liquor, take off the scum which arises.

On the BOILING, CRYSTALLIZATION, *&c. of the* BEET SUGARS.

FIRST boil the extracted saccharine liquors down to the consistence of sirup; then put it into a copper, of which one third at least is empty, and let it boil away, by a moderate fire, until a vial which holds one ounce of water will contain eleven drachms of the sirup, or until the sirup pours somewhat broad from the ladle.

As the froth or scum arises, it must be carefully taken off. When the sirup is arrived at the point above mentioned, by gentle boiling, the fire must be removed from underneath the copper, and the sirup gradually run through a clean woollen cloth placed over a wooden or stone vessel.

The sirup must not cool too much before thus filtered, otherwise it becomes ropy; when the filtered sirup is somewhat cool, it should be laded into shallow wooden or stone vessels, to crystallize:

shallow earthen vessels, such as are used to produce cream, are proper for the purpose. Vessels made of tin will answer.

These vessels, filled with sirup, must be placed in a room heated from fifteen to eighteen degrees of Reaumur's thermometer, or sixty-eight of Fahrenheit's; and care must be taken to keep them clear from flies and dust.

If the sirup has been of a proper consistence, crystals will soon begin to form at the bottom of the vessels: and in the space of eighteen or twenty-one days the crystallization will be completed. The mass must then be put into a strong linen sack, well secured, and placed under a press to squeeze out the liquid from the sugar which remains in the bag; the liquid matter may be set to crystallize a second or third time, and will yield sugar of a coarser quality. A cheese press or long lever will serve for the purpose of pressure.

The sugar first obtained may be rendered purer by well mixing therewith a small quantity of clear spring water, and placing it again under the press; the coloured sirup will then run out, and leave the sugar in the bag in a much purer state than before: by repeating the operation, it is so far improved, that, when dried and rubbed, it becomes a fine white powder sugar.

The separated sirups should be again carefully boiled, and more sugar will be obtained from them by crystallization.

If the sugar procured by the first pressure be dissolved in as much clear water as will form a sirup, and placed again in a warm room to crystallize, it will yield a much purer and harder sugar; the sirup may then be separated without pressure from the sugar, merely by inclining the vessel, and allowing the sirup to run off from the crystals.

All the sirups prepared as above directed, are fit for family use, and are much superior in taste to those prepared from the pressure of the raw or boiled roots.

The remaining thick sirups may be used as treacle or molasses, and will serve to distill for rum or spirits.

The process above mentioned is so simple and easy, as to be within the reach of every farmer to accomplish; on which account I have entered more minutely into a detail of it. I shall now annex some other observations, principally drawn from the experiments of Professor Lampadius, of Freyberg, near Dresden, by which it appears that Beetroots contain water, fibrous matter, sugar, mucilage, glair, starch, colouring matter, scented matter, and a bitter substance. The water is in the proportion of from one half to two thirds of the weight of the roots; the fibrous matter of the roots differs, and is considerably more in poor than rich land; the saccharine particles vary from two to five per cent.; the mucilage is from three to five per cent.; and the glair, or matter resembling white of egg, is about one per cent.; the starch is in very small quantity, being only about two or three ounces in a hundred weight: the colouring matter undergoes several changes by exposure to the air, as yellowish, brown, and red, and may be precipitated by acetite of lead: the scented matter is volatile; it rises in distillation of the root with water, combines closely with spirits of wine, and this matter occasions a peculiar contraction in the organs of taste. By boiling the Beet-roots the smell and taste are very much lessened. The bitter substance is soluble in water, and remains behind in the first sirup after the crystallization of the sugar.

The following are some experiments of Professor Lampadius.—One hundred and ten pounds of Beet-roots, the Beta cicla of Linnæus, or white English Beet, washed, peeled, cleaned, and then grated, gave a mass which weighed eighty-seven pounds; out of which were pressed forty-one pounds and a half of juice, which was boiled with twenty ounces and a half of charcoal powder: this, when filtered and evaporated down until crystallized, produced full five pounds of a brownish yellow-grained sugar, also five ounces of brown sirup.

The above brown sugar, after being dissolved in six pounds of lime water, mixed with one pound of blood, then boiled, filtered, and afterwards evaporated, yielded four pounds five ounces and a half of purified brown sugar, and six ounces and a half of sirup.

The four pounds five ounces and a half of sugar thus prepared, were again dissolved in six pounds of lime water, mixed with one pound of milk, then boiled for a quarter of an hour: during the boiling, a small quantity of white wine vinegar, and a little more milk, were added;

the saccharine matter was filtered, and treated as before; the product was four pounds of well-grained white powder sugar.

The residuum after pressure, the brown sirups of the two first processes, and the remains of the filtrations, weighed, when collected, forty pounds: they were mixed with one quart of yeast and eighty quarts of water, heated to 40 degrees of Reaumur's thermometer, or 112 of Fahrenheit's, and, after fermenting forty-eight hours, were distilled. They furnished, at the first distillation, fifteen quarts of weak spirit, which, on a second distillation, gave eight quarts of a better; from which, when rectified, were produced three quarts and a half of spirits resembling rum.

From the result of this series of experiments it appeared, that after paying the farmer for the roots, and discharging all incidental expences whatever, a profit

fit was yielded of nearly cent. per cent. on valuing the four pounds of white powder sugar at one shilling per pound, and the three quarts and a half of rum at one shilling per quart.

It is not to be inferred from these experiments, that the profit from this process will always equal the above; for subsequent experiments have proved that the crops of Beet-roots cannot always be depended upon, nor do they always yield the same quantity of sugar; the produce of different years having varied, from two pounds of sugar per hundred weight of roots, to five pounds, according to circumstances which have intervened.

However, I hope you will find the culture of the Beet-plant an object of consequence, on considering that its leaves afford nourishment for men and cattle; that its roots may be used as food, or to furnish sugar, one of the greatest luxuries of life; that, after the sugar is extracted, the roots are even then serviceable for cattle; and that the refuse-sirups will produce a wholesome spirit. In dry summers its herbage will be of great service to cattle, and does not give a bad taste to the milk; and in hard winters the roots are wholesome food. The Beta cicla is the Mangel Wurzel, or Root of Scarcity, of Dr. Lettsom, who has said much upon its use as food. Its advantages are now called forth to notice in other points of view, and deserve attention. In particular circumstances it may become a very useful article; time will determine its real merits.

The remarks I have here given you are very short, in comparison with the observations I have collected, which extend through every department of the business. If you want any further information, I will furnish it; but the above accounts appear to me sufficient to engage your present attention.

I remain,

DEAR SIR,

Your affectionate Son,

JOHN TAYLOR.

Leipsig,
May 20, 1800.

To Mr. CHARLES TAYLOR.

The following curious Account of the Method of FORWARDING VEGETATION BY MEANS OF STEAM, was communicated to the Secretary by his ingenious Friend THOMAS WAKEFIELD, Esq. of Northwich, and was presented to the Society by the Secretary.

The first Experiments were made in a Steam-house invented by Mr. Wakefield; the subsequent ones are copied from a Diary written by Mr. Butler, when Lord Derby's Gardener, and were made in a Steam-house built at Knowsley, by Lord Derby. All the Papers and the Drawings were received from Mr. Wakefield.

IN the year 1788, about the beginning of April, Mr. Wakefield being disappointed in several endeavours to procure Bark for a crop of melons in a Dutch pit, twenty yards in length and three in breadth, thought he might contrive to heat it by Steam; and that, if he could succeed, he should ever after save the great trouble and expence of getting Bark in the neighbourhood of Liverpool. In a few hours, in the presence of two or three friends, he made a plan of the flues, arch, &c. according to the present method, and was then so confident of its succeeding, that he sent for workmen the next morning; and in a few days, under his direction, the pit was altered and fitted for the steam method.

From Mr. WAKEFIELD's DIARY.

EXPERIMENT I.

Commenced on the 25th of April, by putting some good melon-plants into three feet deep of strong melon soil. The plants grew very well, and were remarkably strong and luxuriant, but set no fruit till the 25th of July; they then produced an abundant crop, excellent in flavour, thin-skinned, and thick-fleshed. It is now clearly proved, that their extreme luxuriance and backwardness in setting their fruit, was owing to the depth of the soil, as will be seen in the following year's experiments. It holds good in the fruiting of plants in general. Small pots will throw pines into fruit. Trees planted in deep soil, particularly pear-trees, are a long time before they fruit.

EXPERIMENT II.

1789.—Supposing that last year's soil was too rich, I planted this year in the same depth of a weaker soil, with a considerable addition of good clay marl, but less dung; thinking I should prevent, by this mean, the vigorous progress of the roots: but from the prodigious vegetating power attending this method, the plants grew equally luxuriant. Still they had no propensity to set their fruit until about the same time of the year: the crop was again abundant and excellent. It was no uncommon thing for the fruit to grow in clusters of two and three, similar to walnuts; and universally each melon of the cluster ripened at the same time, and came to its full growth. Every thing is nearly the same as last year.

EXPERIMENT III.

1790.—As I now began to imagine that the depth of the soil occasioned the great luxuriance of the plants, I reduced it to two feet in depth. In consequence of this, the plants set sooner, but still late, and were too luxuriant. They produced, however, a most excellent crop, as well as in the former years.

EXPERIMENT IV.

1791.—Being now convinced of the necessity of not having the soil too deep, and wishing to ascertain the best depth, I filled the large pit with soil in such a manner as to have a regular slope from end to end: the deepest part was two feet and a half, and the other one foot. The result was curious and interesting; for the fruit in the different lights set in regular succession, week after week; those plants fruiting first in the soil of one foot in depth. The crop was abundant; and on the deepest part of the soil, every thing was nearly as in the former years.

EXPERIMENT V.

1792.—This year the melon-plants were planted in fifteen inches of strong melon-soil, upon two feet of bark, that had been used two years before in the same pit, to prevent the steam from acting too powerfully on the soil, and to raise the plants near enough to the glass. All now succeeded well. The fruit set as well as on bark or dung, but was infinitely more luxuriant and productive.

During the last five years, the steam has been abundantly used in Mr. Wakefield's vine-house, with a success beyond his expectation. The first year the steam was used, the vines were much more luxuriant, and grew at least a month longer than formerly: to this circumstance the abundant crop of fruit the year following was in a great measure attributed, as it afforded time, after the fruit was gathered, for the embryo fruit to form in the buds for the ensuing year. Till now, it has been found difficult to furnish the plants with sufficient nutriment, both to ripen an abundant crop of fruit, and to swell the buds to that degree which is requisite to secure a good crop for the ensuing year. Through a want of this power, it frequently happens that vines, as well as other plants, seldom produce abundant crops for two successive years; but by the present method, Mr. Wakefield's vines have produced, for the last four years, fruit in the greatest abundance, and of the best quality; the grape-berries being much larger than formerly, thinner skinned, and better flavoured. But a sufficient proof that the vine delights in this atmosphere is this, that if steam be sufficiently supplied during the whole of the summer, the leaves every morning will be pearled round the edges with drops of water exuded from the plant. This is frequently seen in every house during the spring, when the earth and the atmosphere are charged with moisture, for then vegetation is in the most luxuriant state. But this indication of vigour is never seen at any other season in the old method; and from the want of it, the red spiders too frequently make their ravages, though, when steam is given in sufficient quantity, that destructive insect is never seen.

From Mr. BUTLER's DIARY.

A periodical Account of Experiments made in forcing esculent Vegetables by means of STEAM, *with their success, as practised in a house erected for that purpose at Knowsley,* 1792.

Sept. 13.—Laid the foundation of a steam-house, forty-two feet in length, and twenty-two feet in width; the back of which is in height fourteen feet, the front five feet six inches, and the surface contains nine hundred and twenty-four feet.

I have generally found, that in well-constructed pine-houses (if not very much exposed) one fire is allowed for every four hundred square feet; as less than this, in very cold weather, would be insufficient to maintain a proper degree of heat, without making the flue too hot, and thereby generating a destructive atmosphere. If a greater number of fires were allowed, they would probably, in unskilful hands, or when left in the night, over-heat the stove. My reason for the extra one hundred and twenty-four feet to two fires (the number this house contains), was either to prove to a certainty that less fire is required by using the Steam than in the old method, or to be practically convinced that the contrary is true.

Jan. 1, 1793.—Sowed some cucumber seed of the Southgate long prickly kind in a one-light frame, placed on a dung bed, not only to raise plants for the steam-house, but also to ridge out on dung, to be treated according to the Southgate method, being the most approved and expeditious method hitherto known of raising cucumbers. The bed being in fine order, the seed quickly vegetated, and grew very fast. They were also fit to stop, having thrown out two rough leaves by the time the house above mentioned was finished, which was the 1st of February.

EXPERIMENT I.

Feb. 1.—This day ridged out six holes or lights on a dung-bed, it having been in preparation three weeks, and put twenty holes in boxes in the steam-house, placing them on the dry flue, in the back of the house. Also planted some French beans in pots, and placed some roses, pink carnations, and hyacinths, in pots, on the kirbs and pit.

Success of Experiment 1.

Cut a handsome fruit on the 28th of February, being eight weeks and three days from sowing the seed, and four weeks from the plants being first brought into the steam-house.

Feb. 3, 1793.—Found that the cucumber plants standing on the flue did not answer. Placed some of them on a shelf close to the back wall, being two feet from the glass, and also placed others on the surface of the pit.

The quantity of water evaporated the last night was twelve gallons. Found that this was rather too much, the plants being very wet, and dropping from the glasses very fast. The mercury in Fahrenheit's thermometer was, in the morning at seven o'clock, 64 degrees. A similar thermometer, plunged into the old bark, rose to 100 degrees. This is a very kindly heat for tan.

Feb. 6, 1793.—The plants of cucumbers look exceeding well; those on the shelf and those on the bark keeping pace with each other. The runners push on with a vigour and regularity I never before witnessed. The leaves are unusually dark; and on the shelf some fruit are showing.

The French beans are appearing very uniformly through the soil.

The roses vegetate in a manner truly astonishing. It is usual to see them, in the common method, break only from one eye, which is generally that at the extremity, while the rest remain dormant; but here every bud seems to be eager for the lead, and, as in a kindly showery May, promise a profusion of flowers. The pinks are beginning to spindle; the carnations not much; but the progress of the hyacinth is wonderful. Quantity of water evaporated, ten gallons. Night thermometer, 66 and 101 degrees.

Feb. 8.—Cucumbers still grow rapidly. Those in the frames look as well as they generally do, but are by no means equal to those in the house. The progress is by no means equal; those in the house, with steam, growing as much in twenty-four hours as those in the frames in forty-eight hours.

EXPERIMENT II.

Brought in this day one cherry-tree, one peach, one apple, and a vine-bud. The cherry, peach, and apple, were maiden, or one-year old, from the bud or graft the last February, viz. 1792, being a May-duke cherry, a Royal George peach, and a Nonsuch apple, in pots. These were placed on the kirb of the stove. The vine had made about three feet of wood the preceding summer, and nearly the size of a quill: I put it into a pot filled with one half rotten turf from a loamy soil, one third rotten cow's dung, the remainder sand; the pot was eighteen inches over, and twelve inches deep. At the same time I headed the vine down to two eyes.—Brought in a pot of myrtle, geranium, and jessamin cuttings, and plunged them into the old bark.—The roses, &c. grow very strong and rapidly.

Quantity of water evaporated, sixteen gallons, or thereabouts. Thermometer suspended in the house, 68 degrees.

Feb. 14, 1793.—On the 12th sowed some cucumber-seed in a pan, and plunged it into the bark. Cucumbers still astonish me with the progress which they make—shew plenty of fruit.—Brought some potatoes into the steam-house—

roses show a great many buds—hyacinths and pinks come forward very fast—peach, cherry, and apple do the same—some cherry bloom ready to burst out.—I found the plants rather too wet this morning, so only gave nine gallons, or thereabouts, to be evaporated this night.

Feb. 16.—Every thing going on well—first cucumbers came into bloom. Thermometer 67 degrees.

Feb. 17.—Peach, cherry, and apple, in full bloom—every thing else going on well—cucumbers sowed the 12th finely up—those first brought in, show plenty of fruit-bloom.

Feb. 23.—Cherry-tree blossom falling off, being evidently too hot—about a dozen set, but are evidently in too confined an atmosphere, wanting more air than the other things in the house.—French beans remarkably vigorous—potatoes coming up very fine: roses and other flowers look remarkably vigorous, as also cucumbers. The peach and apple bloom looks very fine. The cucumbers, in common frames, do very well, but are much behind.

Water evaporated about ten gallons each night. Thermometer, from 66 to 70 degrees.

Feb. 28.—Cut first cucumber in steam-house, being seven inches long, having been twelve days in bloom, twenty-eight in the house, and fifty-nine from sowing the seed. Cherries all turn yellow, and drop off—apple bloom does the same—too hot for them.

Peach does pretty well—every thing else still astonishes me with the rapidity of its growth—leaves of French beans and cucumbers highly beautiful—look as though they were in their true element—some of them are fourteen inches long, and as black as a hat.

March 1.—Every thing growing with a rapidity truly wonderful.

Water evaporated eighteen gallons each night. Thermometer, 68 to 73 degrees.

March 5.—Cut cucumbers, some of them eight inches and a half long: those in the common frame look very well—show fruit, and have two set.

The peach-tree has a great quantity of fruit set on it, which look remarkably well, and are free from insects.

EXPERIMENT III.

March 8.—Brought a great quantity of pine-suckers of last year—having disrooted and plunged them into old dust of bark, being the small bark riddled out of the old stoves.

Cut eight cucumbers, some of which were ten inches long—hyacinths, narcissuses, and jonquils, in fine bloom.

March 10.—Gathered first French beans, being remarkably fine. The quantity of cucumbers, in their different stages of growth now on the vines, is almost incredible: the plants are vigorous beyond description. Indeed this is the case with every thing in the house. No insect yet appears; the thrip is not even on the French bean over the entrance of the dry flue.

Water evaporated, eighteen gallons per day.—Thermometer, 68, 70, and 73, by night; but by day 80, 90, and 100—when plunged into the bark, 105 constantly.—A fine heat—give a little air every day about ten o'clock, if the wind is not high, and there is no rain.

March 15.—Every thing succeeds, and answers my most sanguine expectations. Turned out a pine plant; find it has got a fine root quite to the outside: the pot pines look remarkably well—suffered less from losing their roots than in the common mode of treatment. Cucumbers sown in this house as fine as those raised on dung.

Cut first-fruit in the common frames, being fifteen days behind the steam. The plants have received no check, and look very fine: six weeks and one day have elapsed from ridging out, and ten weeks and four days from the sowing the seed.

Water usually evaporated is about twenty gallons, if a fine night and dry with wind; but if wet and close, ten or twelve will be found sufficient for a house of this size.

March 18.—Find the bark growing too hot for the pines—raised them half the depth of the pots out of the tan.

March 20.—Every article before enumerated doing well; obliged however to give over much steam, as the bark, although small and solid, is heated to a greater degree than I ever knew any such substance to be heated. The quantity of cucumbers now cut from this house is astonishing; some to the length of eighteen inches.

March 25, 1793.—Heat in the bark still continues very violent, although the steam has been discontinued since the 20th. The peaches swell very fast—

pinks in fine flower—a fresh quantity of moss and common Provence roses brought into this house—the first removed into the peach-house—vine-bud advances very rapidly, and is remarkably strong. Thermometer, in the night, 69 and 70 degrees; in the day, 80, 90, and 95.

March 30.—Heat begins to decrease—the disuse of the steam visible in the countenances of the vegetables: cucumbers are however very prolific. Begin to steam again this night, leaving open all the apertures. On one plant count ten cucumbers swelling off. Plants in the frames very healthy; but cannot find any plant with more on it than four or five.

April 6.—Heat in the bark again begins to increase—poured cold water on it, between the pots of pines, and find it has a very good effect.

Cut, since March 30th, one hundred cucumbers, most of them very fine ones—

the plants very healthy—leaves larger than common—French beans, peach, vine, and flowers, do equally well. The cuttings of jasmine, geraniums, &c. strike with wonderful facility.

April 10.—Nothing can exceed the fecundity of the cucumbers, the rapidity of the growth of the vine, and swelling of the peaches.—Their health and perfect cleanliness from insects are admired by every one—indeed they exceed my most sanguine expectations. Nothing fails but the addition of potatoes, as was before mentioned, for which the air requisite for the other things is not proper; for they are drawn up very weak. Notwithstanding, I have found some potatoes in each pot; but they are not in their degree of heat.

April 20.—I still find that the source of the steam being under the pit, is a great evil, as I am obliged to use it less copiously than most of the things which the house contains require. The pines being plunged into the bed when the body of the bark is sufficiently heated, I am obliged to do without steam, as I cannot procure it, without adding heat to the bark.

To prevent this inconvenience, see the remarks made by Mr. Wakefield, in his subsequent Letter, dated Oct. 6, 1800.

For want of steam, the aphis and thrips are making their appearance, neither of which, I firmly believe, would ever have been here had the steam been continued. However, as the pines are now the prime object, since cucumbers, French beans, &c. may be obtained by any mode of forcing, I attend solely to the quantity of steam the pine requires, or to what the bark requires to keep it in a proper degree of heat. Peaches swelled very fine, and are likely to be soon ripe.—Removed them into the peach-house.

May 15.—I find that steaming once in three or four days, having watch sticks in the bark to ascertain the degree of heat by, is sufficient. I have about three feet of old bark on the perforated arch, which is as firm as treading and five months settling can render it. If it was quite cold, I think it would require two days to bring it to a growing heat. After that, it will, as before said, require the steam and dry flue once in three or four, or perhaps not more than once in six days, to be used.—The quantity to be ascertained by the degree of heat required.

June 1793.—Pines continue to do pretty well; but I think if they were by themselves, and there were no cucumbers, &c. in the house, they might be managed better.—As soon as the steam is disused, the thrips and aphis insects appear, but quickly disappear on applying it again.

July. — Pines still grow very fine—cucumbers do not so well, as I cannot steam, for fear of hurting the pines, except when I am in want of heat in the bark, which may at any time be obtained in sufficient quantity when the steam is used.

August.—Having determined to use the steam-house only for forcing cucumbers, French beans, melons, &c. and not pines, I removed the young plants into their fruiting pots, and placed them in common stoves.

Sept. 2.—Having removed the young pines, the steam is now constantly employed.—Brought some young cucumber plants from a dung bed, and transplanted them into boxes placed over the back of the pit within two feet of the glass; still preserving those on the shelf at the back, though apparently going off.

Sept. 8.—Brought forty pines in fruit, and plunged them half way to the rim in the old bark, these being the same as were placed in the house in February.—Found it growing very hot by constantly using the steam.—The old cucumbers, at the bark, begin to assume a new appearance, and put forth fine runners. Took two of the boxes from the shelf, and placed them on the bark lengthways of the pit.

Sept. 10. — The young plants sown August 21, are astonishingly fine; the old ones set on the bark are likewise very fine: but those on the bark-shelf appear not so likely to produce a lasting crop as young ones. I removed them, and placed some young ones in their room.—Found much less steam required than in the spring; and that twelve gallons were sufficient for two, and, if moist or rainy weather, for three nights.

Sept. 15. — Cucumbers continue to grow very rapidly—pines swell very well—and this day brought in some French beans.

Sept. 20.—Cucumbers grew very rapidly, as also French beans—pines swell very well—potatoes were planted this day in boxes five inches deep, and two feet wide, having been previously sprit.

Sept. 25.—Every appearance indicates a very successful experiment of winter-forcing. Cucumbers show abundance of fruit. French beans and pines look very well.

Oct. 1, 1793.—Cucumbers look very strong, and are showing abundance of fruit. The leaves are remarkably large, and of a very deep black colour.—Found I had committed an error in stopping the apertures between the laps of glass with putty, as the steam does not pass off sufficiently quick.

Oct. 4.—Several fine fruit shows on the cucumbers, which look remarkably fine. Pines swell very fast, there being an amazing heat in the bark. Water evaporated, only six gallons last night.—Thermometer, 67 at night, and 80 degrees in the day; when plunged in the bark, 105 degrees.

Oct. 10.—Cucumbers continue very fine, and as luxuriant as ever I saw them; but do not show so much fruit as in the spring—some few are swelling, and one is in great forwardness. Pines swell their fruit very fast. French beans are finer than I ever saw at this season of the year.

Oct. 22.—Cut a fine cucumber this day, being seven weeks and three days from the time of sowing seed; a great number swelling off. Pines and French beans still do well. Water evaporated, from six to ten gallons per night, according to the weather.

Nov. 1.—Cut some fine fruit this day from the cucumbers, and some pines that have a very good appearance.

Took the vine out of the pot, and placed it in a pit that had no fire, to harden the wood, having made a shoot from a very small plant, as before mentioned, of forty-two feet in length, thirty of which is fine firm ripe wood, with very round prominent eyes—not the least appearance of a root coming through the holes of the pot.

Nov. 10.—I was very much disappointed this morning in finding that the flue under the arch had burst, and that there had been much smoke and sulphur in the house all night. The destruction this had occasioned among the plants in the house was great. The French beans, and all the young fruit and tender branches of the plants, were totally destroyed. This misfortune happened through the negligence of a bricklayer in not cleansing the flues.

Nov. 20.—After the misfortune that happened on the 10th instant, I conceived that nothing more was to be expected from the cucumbers. I immediately had the flues cleaned; and having continued the steam ever since, I found that they were breaking out fresh and strong, and showing abundance of fruit. Had the plants received such a shock in a frame, I am certain that they could not have been so quickly brought about by any method, and I much doubt whether it would have been possible to effect it at all.

Nov. 25.—The cucumbers are doing well, beyond any conception I had formed, after experiencing the last misfortune. French beans are tolerably good; but I find that want of light is the only mischief which we have naturally to encounter.

Sowed some cucumber-seed in a pan, and placed it in the steam-house.

Dec. 1.—Cucumber plants sown the first are up, and look very well—the old ones show abundance of fruit, but do not swell them off freely.

At the time of erecting this house, I conceived that it was necessary to have it as air-tight as possible; and therefore I stopped every crevice, and laid putty between every square at the lap. I think it would have been better, had they been left open, and am now taking away the putty.

Dec. 24.—Since the first instant I have experienced, that to stop the apertures between the squares with putty is an error; for, since I have removed it, the plants which before were always too wet, are now easily dried by using the dry flue, even in dark wet weather. The fruit on these plants swells more freely, and the young plants look very well.

Brought in this day some hyacinths, roses, carnation, pink, and syringa roots. The weather being dark, used but little water, ten gallons per evening being the mean quantity. If windy, more, if rainy, less is required. The plants should just be tipped on the edges in a morning, similar to the vegetables in a summer morning which has been preceded by a showery day. No certain rule can be laid down how a knowledge may be obtained of the quantity of water requisite to gain this desirable criterion of good management. An attentive observer will soon be able, by the appearance of the atmosphere, to judge the quantity requisite, both of heat and moisture.—And here I would wish to give it as my opinion, that nature does not act by rules in rearing her tender saplings, but often changes her mode of treatment, from one extreme to another, in the space of twenty-four hours: I do not mean to say, that plants raised by art are as capable of sustaining such rude shocks as those left to nature; but this I believe, that more are killed by kindness than by bold management, both in the animal and vegetable world; from whence I infer, that a few degrees of difference in heat, or a few gallons of water, will not be productive of any bad consequence.

Nov. 29.—Stormy day—admitted a little air by propping up the bottom lights with a stone. The weather being windy, kept the holes open for the steam the greater part of the day. Cucumbers look very well—pines swell very fast. My foreman says that the Black Jamaica has swelled half a pound since it was first brought here.

Water used last night and to-day, ten gallons. Thermometer, 68 degrees at night—plunged into the bark, 101 degrees.

Dec. 6.—The season is at present as unfavourable for forcing as possible; and the steam has not been used so much as if the weather had been dry and windy. Every thing looks tolerably well, and some cucumbers swell as freely as any I ever saw. French beans grow better than I ever saw at this season; and a few pines swell very well. However, I have no doubt, if the weather was not quite so wet, and I could use the steam more copiously, but that I should be better satisfied.

1795. *Jan.* 6.—Cut this day, from the steam-house, seven as fine cucumbers as I ever saw in the month of May. The weather being frosty and clear, the steam is now used to great advantage.

tage. Fruit, that during the dark weather looked bright and well, but remained suspended as soon as the atmosphere became clear, and the sun burst forth, swelled away with a rapidity scarcely to be credited. The French beans are growing equally well. Pines swell very fast, and the cuttings of the Hydragonum Hortensium, and Rosea semper flora, strike with great facility.

Thermometer, suspended in the house, 68 degrees in the night—plunged into the bark, 100 degrees Nairne. In the open air, 26 degrees 6 minutes below freezing.

Jan. 13.—Cut nine fine cucumbers, and gathered a quantity of fine French beans. The weather still frosty, and consequently clear. Pines swell very fast. Thermometer, suspended in the house, 70 degrees, Fahrenheit's scale; 100, plunged into the old bark; 20 in the open air; and 12 below the freezing point.

Water evaporated, about twenty gallons per night, much more being requisite in frosty than in mild weather. Quantity of coals burned, during the last twenty-four hours, three baskets, which are nearly equal to four bushels.

Jan. 20.—Cut this day thirteen cucumbers, and gathered a fine dish of French beans. Every thing is in as flourishing a condition as it is possible to conceive. Pines swell very fast. Thermometer remained, during the night, at 61 degrees. Sharp frost.—Thermometer, in the open air, 19 degrees 18 minutes, being 13 or 14 degrees below freezing.

Water evaporated, twenty gallons during the night, viz. from three o'clock P. M. until seven o'clock A. M.

Jan. 22.—Though the thermometer has been in the open air the last night, at 16 degrees, being 16 degrees below the freezing point, yet the plants in this house look as well as ever, the cucumbers having swelled their fruit as freely, or more so, than when the thermometer stood at 36 or 40 degrees.

Jan. 24.—Though yesterday and this day have been cloudy, and attended with some snow, (the thermometer in the open air being at 25 degrees Fahrenheit) yet every thing flourishes admirably. The cucumbers are as fine as they can be conceived to be, growing very strait and rapidly. Three days since, I cut all that I could obtain; yet I measured one this day, and found it to be nine inches, which, on Tuesday the 20th instant, was only six inches in length. There is a beautiful bloom on it, and such as appears on those growing in dung in April, when the bed is in a fine growing state.

The young plants exceed those in the frames in the ratio of two to one. Some French beans planted in the common stove, at the same time as the plants were in this department, are not to be compared with them, as the plants are now in fruit, while the French beans, though they look very well, are not in bloom: the roses are blooming very finely.

Water evaporated last night, fourteen gallons. Thermometer, 70 degrees.

Jan. 26.—Cut this day seven brace of cucumbers, as fine as any I ever saw cut in April from dung-beds. I likewise cut some French beans. Pines swell very well; one that showed its fruit in 1794, and was then brought into this department, is now changing colour. The one that showed fruit in November, is swelling very fast. Thermometer, 70 degrees; in the open air, 44 degrees thawing.

Water used, twenty gallons in twenty-four hours.

Jan. 30.—The frost which is again set in, was last night remarkably severe; the thermometer being at 15½ degrees. Yet nothing can exceed the beauty and healthful appearance of every thing in this house. It has been the opinion of some experienced in horticulture, that it would be impossible to do any good with steam in very severe frosss; but I always entertained a different opinion, and am highly gratified to find that I was not mistaken. It is now nearly two years since I first began to try experiments with steam; and one circumstance only excepted, viz. the accident of the flue's bursting, in November, 1793, I have uniformly found every thing in this department always clean, healthy, and vigorous, beyond any instance I have ever witnessed; and I have no doubt, should I live two years longer, of being still a witness of its wonderful efficacy in assisting vegetation, and of being enabled, during the spring and summer months, to bring every species of fruit to perfection, without the danger of being disappointed through insects, the natural consequence of a dry heat.

Feb. 3.—Laid a foot thick of rich soil on one half of the pit in this department, in order to turn some pine plants that are just showing their fruit into it, out of their pots.

Cut this day seven brace of very fine cucumbers, a quantity of fine French beans, and a very fine pine, which has never been in any place since it was in bloom but this house; and no bark has been brought in here since February, 1793.

Young cucumber-plants sown in December, 1794, are growing very fast, though the weather is very much against forcing. Last night there was a heavy fall of snow. Thermometer, in the open air, 24; in the steam-house, 70 degrees.

Feb. 9.—Cut this day thirteen cucumbers, and a great quantity of French beans from the steam-house; every thing being in a flourishing state. The earth that was brought into this department on the 3d instant, and laid on the bark, fourteen inches thick, and only half the breadth of the pit, is this day of a fine temperate warmth. Water evaporated, twenty-six gallons last night, being windy. Thermometer, in the open air, 38 degrees.

Feb. 10.—Turned sixty-six pine plants out of their pots, and planted them in the soil over the steam without any bark, the soil being of a fine temperate heat.

Feb. 16.—Cut this day five brace of cucumbers off the plants in this house.

Pines that were turned out of the pots look extremely well, as also does every thing in this house. Water used, twenty-four gallons during the night.

Feb. 23.—Cut this day six and a half brace of cucumbers, and a great quantity of French beans. Cucumbers are amazingly vigorous. Pine plants that were turned out of the pots look extremely well. Water as before.

March 2.—Notwithstanding the weather is very unfavourable to forcing, every thing looks well in this department. Cut this day six brace of cucumbers, and plenty of French beans. The pines look extremely well, and I have this day brought in the miraculous vine, to see if it will effect any thing this season. Turned some plants of cucumbers out of small pots into tubs, there being one fruit on one of the pots. Water evaporated, twenty to twenty-four gallons. Thermometer, 73 in the night, and 80 degrees in the day; when suspended in the open air, 30 to 33 degrees.

March 9.—The weather is still as unfavourable as I ever knew it to be, so that it is with great difficulty that I can look into a frame; which makes a steam-house a very desirable thing, as, through this, necessary attendance may be paid to those vegetables that require it in any weather. Cucumbers are still fine. Cut this day the usual quantity. The pines growing without pots or bark look extremely well.

March 16, 1794.—I never remember such a season as this. So much snow, and so little sun, in March, are very uncommon. In some places the snow is two feet in thickness. I think I could not have had a more unfavourable season for experiments. However the different kinds of plants in this house look very well. Cut this day thirteen cucumbers, and a great quantity of French beans. The pines have a good appearance, and the vine is breaking that bore the miraculous crop last year, and in the same pot, in a manner that is truly astonishing.

Water used, twenty gallons in the night. Thermometer 65 degrees in the night, and 70 degrees in the day; in the open air, 28 to 36 degrees.

DESCRIPTION *of the* STEAM-HOUSE *invented by Mr.* WAKEFIELD,

Fig. 1. THE ground-plan, showing the direction of the flues, upon two of which, A B, are placed flat copper pans, extending from C to D, three inches in depth, and made of thin rolled copper. These pans are fixed in the brick work, and supported by flat iron bars underneath; are inclosed in the steam vaults E, represented in the section of the house, *Fig.* 2; and steam is formed from water poured within them.

The roof of the vault F is a perforated brick arch. See *Fig.* 5, admitting the steam through the tan or soil G G, which is placed upon the arch, after it is covered with small slates or tiles, to prevent the tan or soil, in which the plants grow or are plunged, from trickling through the said arch.

The width of the soil-bed or pit is six feet; the depth of the steam-vault, E, is four feet, from the bottom of the flue to the center of the arch; and the inside width of each of the flues A B, is fifteen inches. The height, from their bottom to the underside of the copper pans, is twenty inches. Each of these flues has a furnace H H, at the opposite ends of the house, and the smoke passes on through the back flues I.

There must be a separate furnace K, for the front flue LM, which flue is within the steam-house, and more elevated than the arch F. Upon this flue is placed a flat copper pan, similar to those already described; this pan extending from L to M, is used occasionally with or without water therein, as may be found suitable to the purposes explained in Mr. Wakefield's subsequent letter.

At N is a leaden-pipe to convey the water into the back pans below the arch: the other pans below are supplied in a similar manner. At O there are square holes, which must be left the whole length of the building, to allow steam to mix plentifully with the atmosphere in the house.

Fig. 2. is a section of the steam-house: for references to the letters, see the accounts above.

Fig. 3. shows the form of one of the copper pans, upon a larger scale. P is the bottom of the pan; Q, the edges placed within the brick work.

Fig. 4. is a section of the pan and flue, to show the manner it is fixed in the brick-work, and the depth of the flue.

Fig. 5. is an upper view of the arch, to show the perforations therein previous to their being covered with tiles.

Dear Sir,

IN answer to your enquiries I inform you, that it is better to have a long copper pan upon each flue, than several small ones. Mr. Butler's pan was made of iron; but copper pans are superior for the purpose.

The Duke of Bridgewater has lately built a steam-house on the present plan, which answers his expectations. I cannot say whether Lord Derby's steam-house is now used or not, as Mr. Butler has left Knowsley, and I have not been there since.

You will observe in Mr. Butler's experiments, that the bark was sometimes so heated by the steam below, as to render the continuance of it in that direction improper; therefore a copper steam-pan has since been placed over the front flue of the stove, and extending the whole length of the front, from

L to M, *Fig*. 1. This copper pan is covered with perforated tiles, similar to those used in drying malt, which afford the opportunity of pots of French beans being placed thereon. This situation is peculiarly favourable to these plants; and, at the same time, permits a sufficient quantity of steam for other plants in the house to ascend through the tiles, from the water heated in the copper pan beneath them.

Where there is no front flue in a vine-house, it will be found very serviceable to fix a flat iron boiler, at the back of the vine-house, in such a manner that the steam may pass from it by pipes through the wall from an arch or cover made over the boiler.

It is necessary, in the construction of all steam-houses, to be particularly careful that the flues for the smoke be sound and perfect, as nothing is more injurious to vegetation than smoke pervading the house from holes or fissures in the flues.

I remain,

DEAR SIR,

Yours sincerely,

THOMAS WAKEFIELD.

Northwich,
October 6, 1800.

To CHARLES TAYLOR, Esq.

Plan of Mr. Wakefield's Steam House.

Pl. VII

Fig. 2.

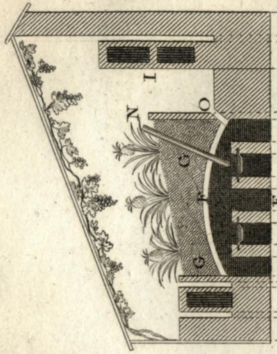


Fig. 1.

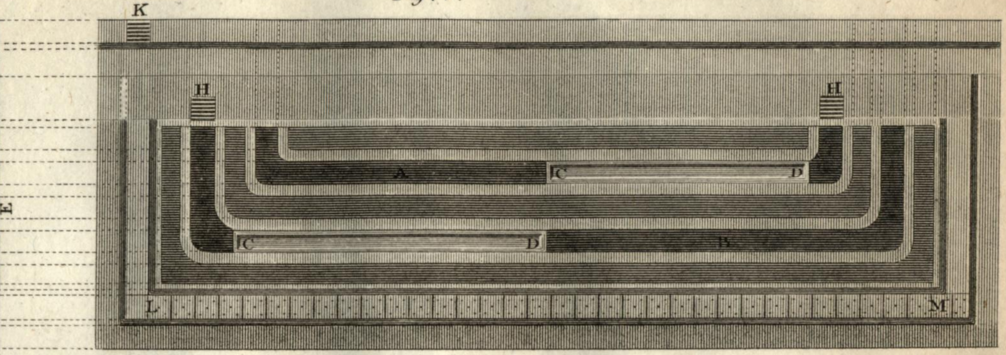


Fig. 4.

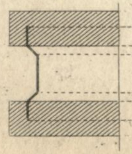


Fig. 3.

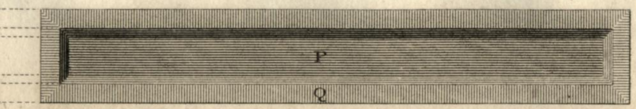
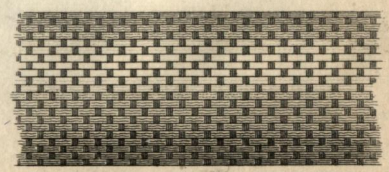


Fig. 5.



Lowry sculp